Technology Opportunity

Modeling and Dynamics

The Modeling and Dynamics Branch at the NASA Lewis Research Center provides software simulations of dynamic (nonsteady) fluid/mechanical systems. The simulations incorporate state-of-the-art approaches such as Computational Fluid Dynamics in order to capture the essential physics of a system, yet the architectures are as simple and fast as possible (often approaching real-time on a workstation platform) in order to provide rapid time integration. Their speed and relative simplicity make them useful for validating control designs and for parametric examination of the dynamic system response (e.g., system identification).

Potential Commercial Uses

- Automobile engines
- Gas pipelines
- HVAC systems
- High performance turbo and reciprocating machinery
- Automated manufacturing systems

Benefits

- Reduces testing costs on new systems—saves time and money
- Reduces product redesigns caused by unanticipated dynamic operability phenomena
- Increases reliability

The Technology

Many systems, whether by design or by accident, are inherently dynamic. That is, over some portion of their operation the relationship between input and output is time dependent. An automobile engine reacting to the changing gas pedal positions, an aircraft gas turbine engine in the process of starting or accelerating from idle to takeoff speed, or a long gas feedline adjusting to rapid changes in the downstream flow valve area are all examples of dynamic systems. Knowledge of system dynamics is crucial for control design and for predicting undesirable performance such as surge in compressors, sag in automobile engines, or resonance phenomena in pipeline flows. In the past, this knowledge has often been accrued through testing of prototype hardware systems. With today's high cost of such hardware tests, the reliance on simulation is increasing. Even with modern computing facilities however, many systems are so complex that unless the simulation software is properly developed, the time and computing resources required for numerous and long time-scale simulations is enormous. NASA Lewis Research Center's Modeling and Dynamics Branch has successfully developed such simulations for rocket engines, gas turbine engines, internal combustion engines, valve systems, high speed aerospace inlets, wave rotors, and other systems. Many of these are first-principle simulations which may be used for existing or future systems of a given type. The simulations deliver output with short turnaround time, ranging from real-time itself to perhaps 1000 times slower than real-time.

Options for Commercialization

Industry standard simulation software for widely utilized systems.

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